Y no dampers

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GB 2322934 A GB 2166863 A GB 1555563 A
DE 003321612 A FR 001347152 A

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(71) Applicant(s)
Halton Oy
(Incorporated in Finland)
Teollisuustie 2-4, FIN-47400 Kausala, Finland

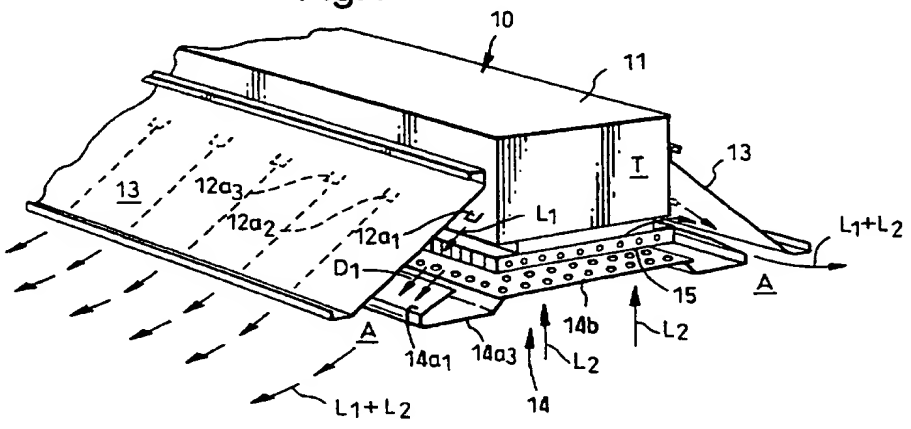
(72) Inventor(s)
Heimo Ulmanen
Lasse Laurila
Reijo Villikka
Mika Ruponen
Kari Aikas

(74) Agent and/or Address for Service
Haseltine Lake & Co
Imperial House, 15-19 Kingsway, LONDON,
WC2B 6UD, United Kingdom

(54) Abstract Title
Air supply device with removable diffuser assembly

(57) Supply air device (10) comprises a distribution box (11) for an inlet air duct (T), said distribution box having air discharge holes ($12a_1$, 12_2, 12_3...) made thereto for discharge of fresh supply air, said air discharge inducing the flow of circulating room air (L_2) passing upward via a heat exchanger (15), located below said distribution box (11), whereby the supply air device induces the circulating air (L_2) entering from the room space in the direction of arrow (L_2) to pass centrally via said heat exchanger and further induces the circulating air leaving said heat exchanger to join the flow of fresh supply air (L_1) blown from air discharge holes ($12a_1$, $12a_2$...). The combined air flow ($L_1 + L_2$) is passed further into a channel (D_1) formed by a side plate (13) connected to said distribution box (11) and a nozzle part of ($14a_1$) of an air diffuser assembly (14), and therefrom further under the guidance of said channel/guide elements laterally sideways from said supply air device. The supply air device (11) includes a separate removable air diffuser assembly (14) mounted below said heat exchanger (15), wherein said air diffuser assembly (14) is rotatable aside, and supported by locking/hinge means ($16a_1$, $16a_2$, $16a_3$, $16a_4$) (see Figure 3e) or entirely removable by releasing said locking/hinge means ($16a_1$, $16a_2$, $16a_3$, $16a_4$) in order to provide access for cleaning the structure.

Fig.1.



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

Fig.1.

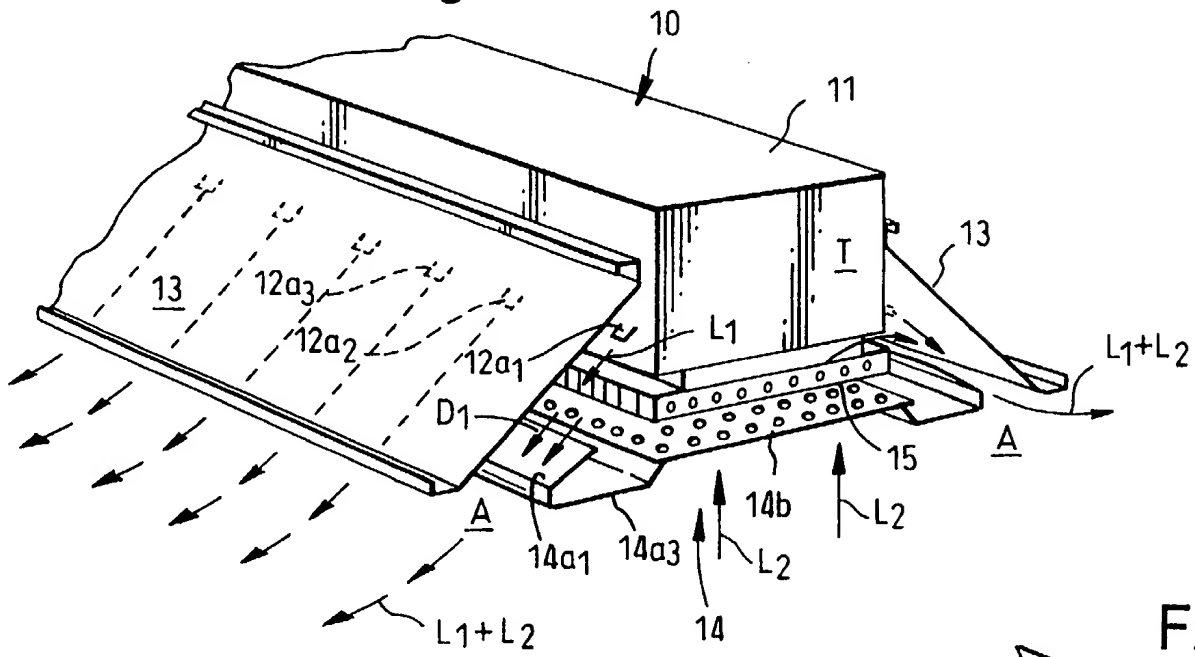
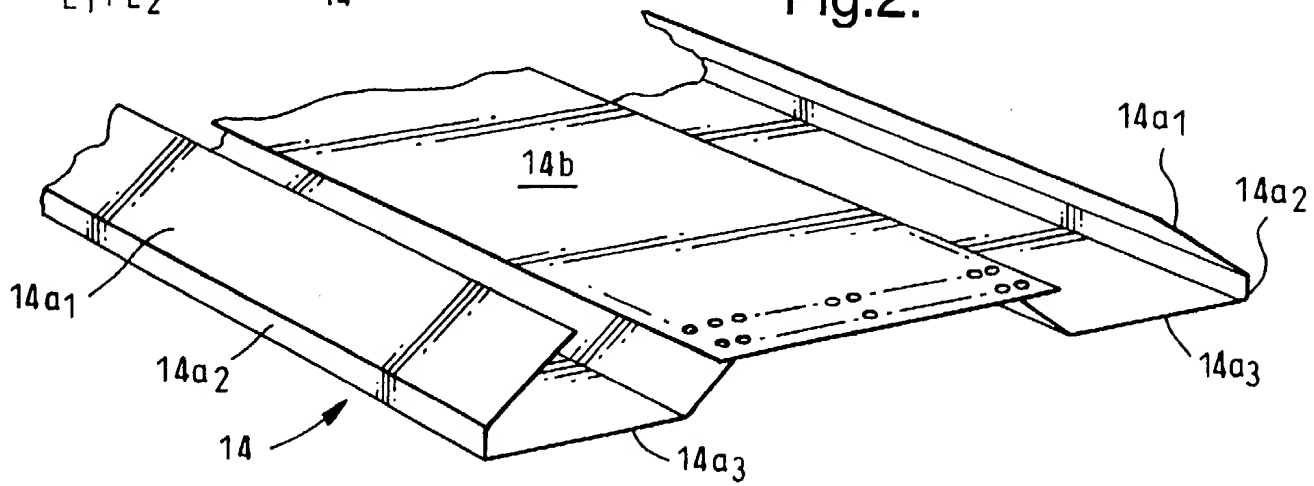

10
11
13
T
13
12a3
12a2
12a1
L1
L1+L2
D1
A
15
14b
L2
A
14a1
14a3
L2
14
L1+L2

Fig.2.


14a1
14b
14a2
14a1
14a2
14a3
14
14a3

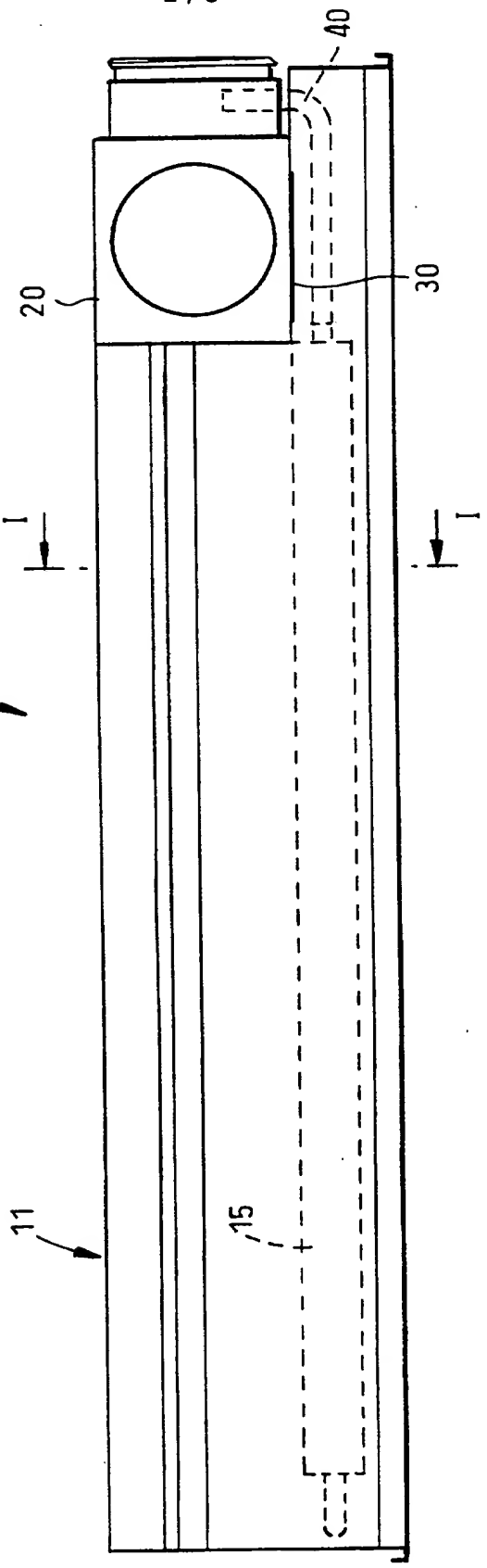


Fig.3A.

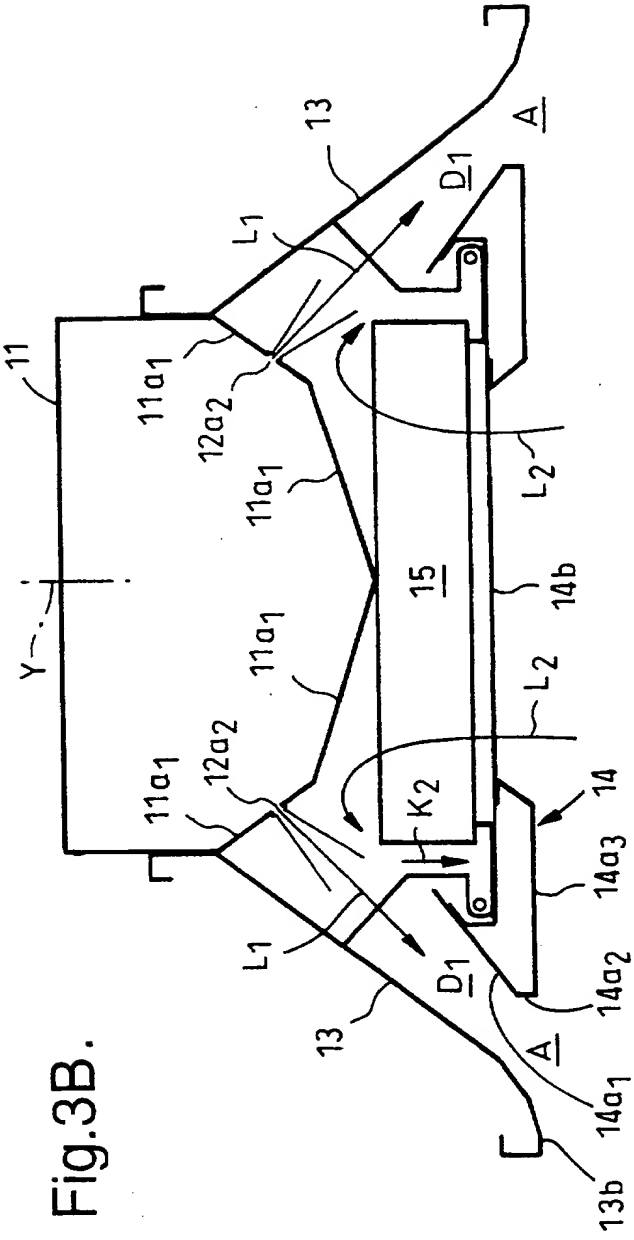

11
11a1
12a2
13
L1
D1
A
L2
15
14b
K2
14
14a3
14a2
14a1
13b
Y

Fig.3B.

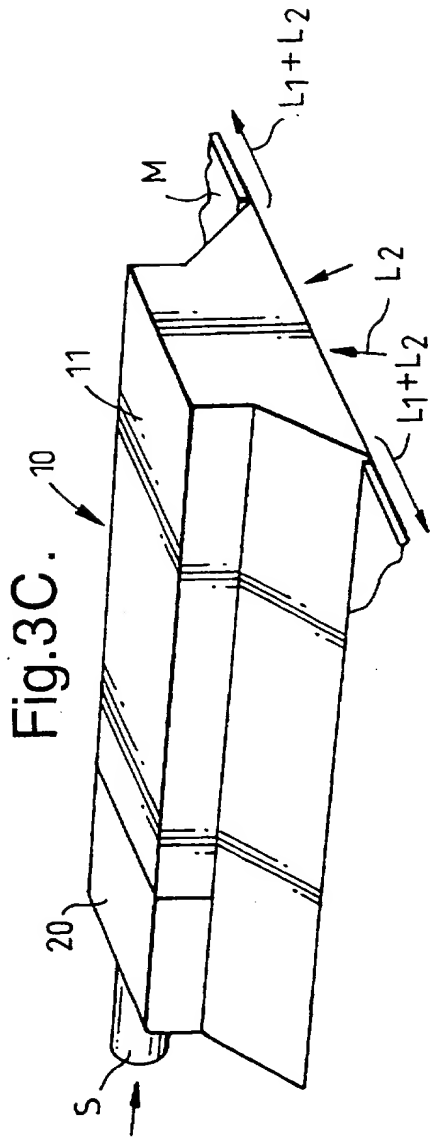

10
11
M
L1+L2
L2
20
S

Fig.3C.

Fig.3D.

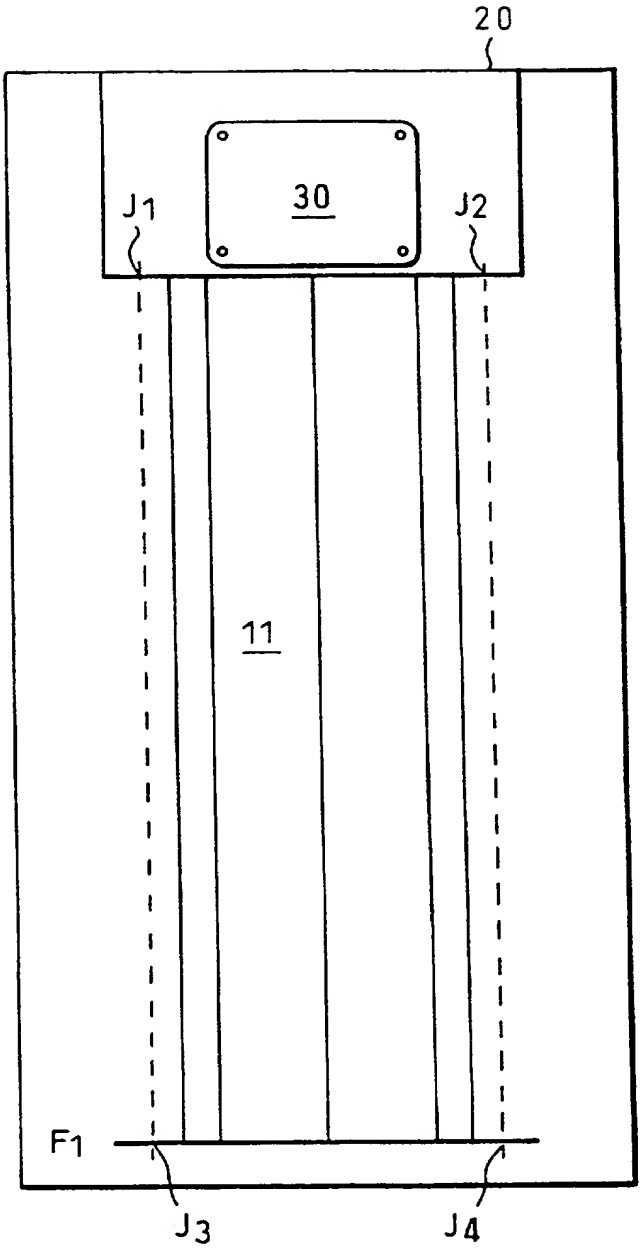


Fig.3E.

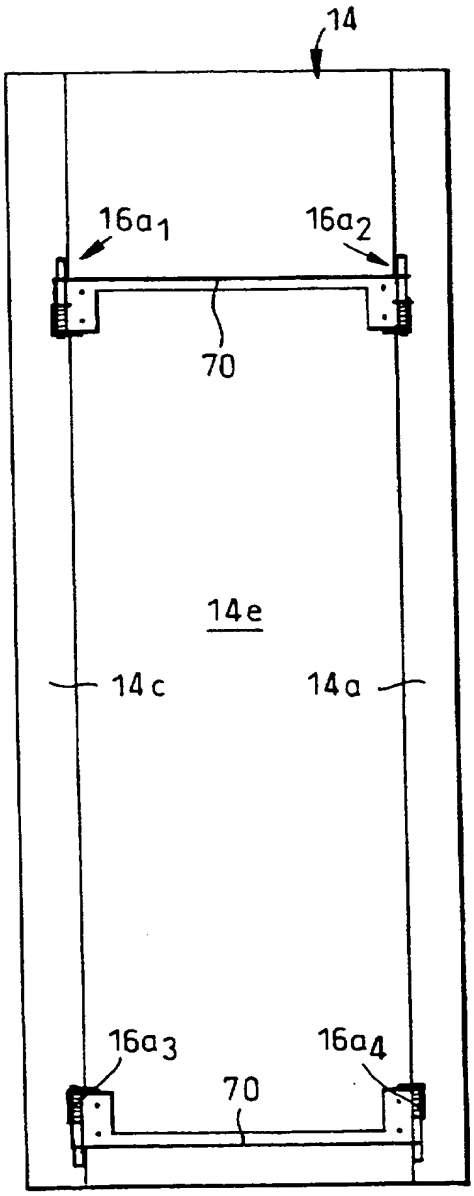


Fig.4A.

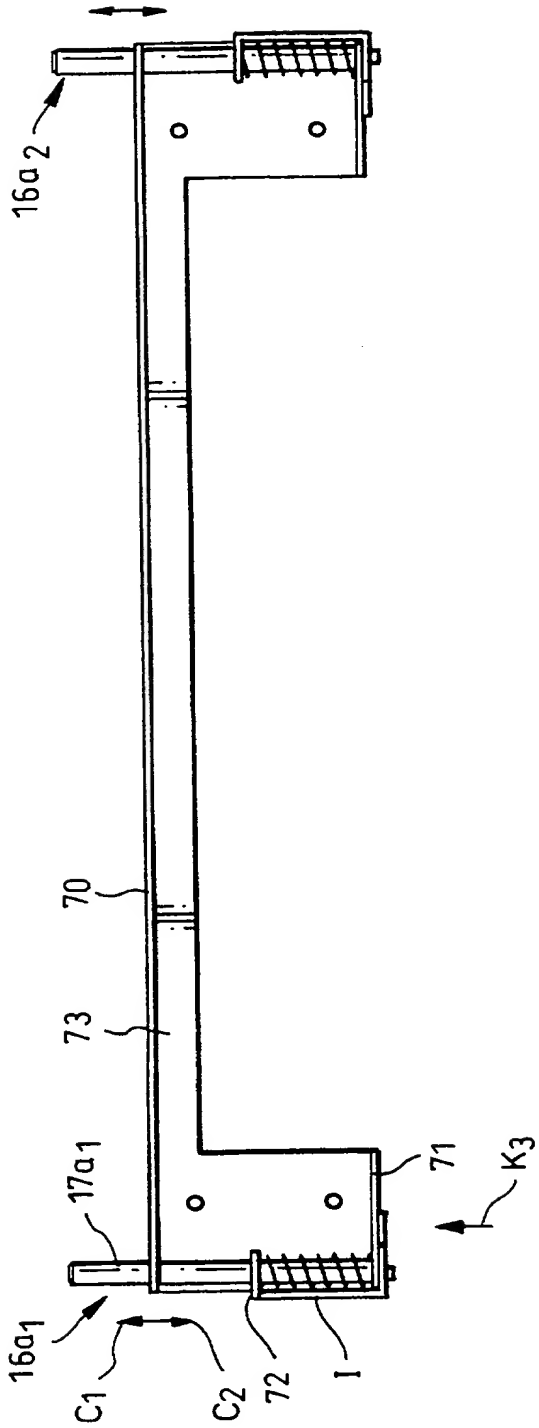
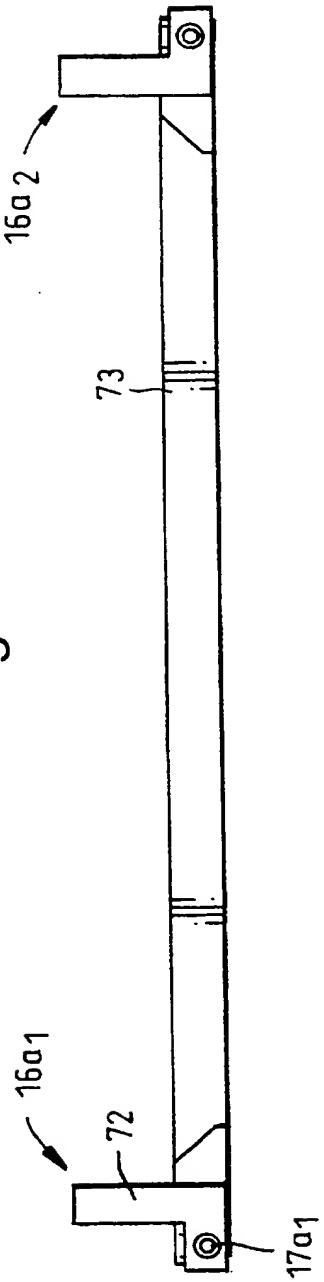


Fig.4B.



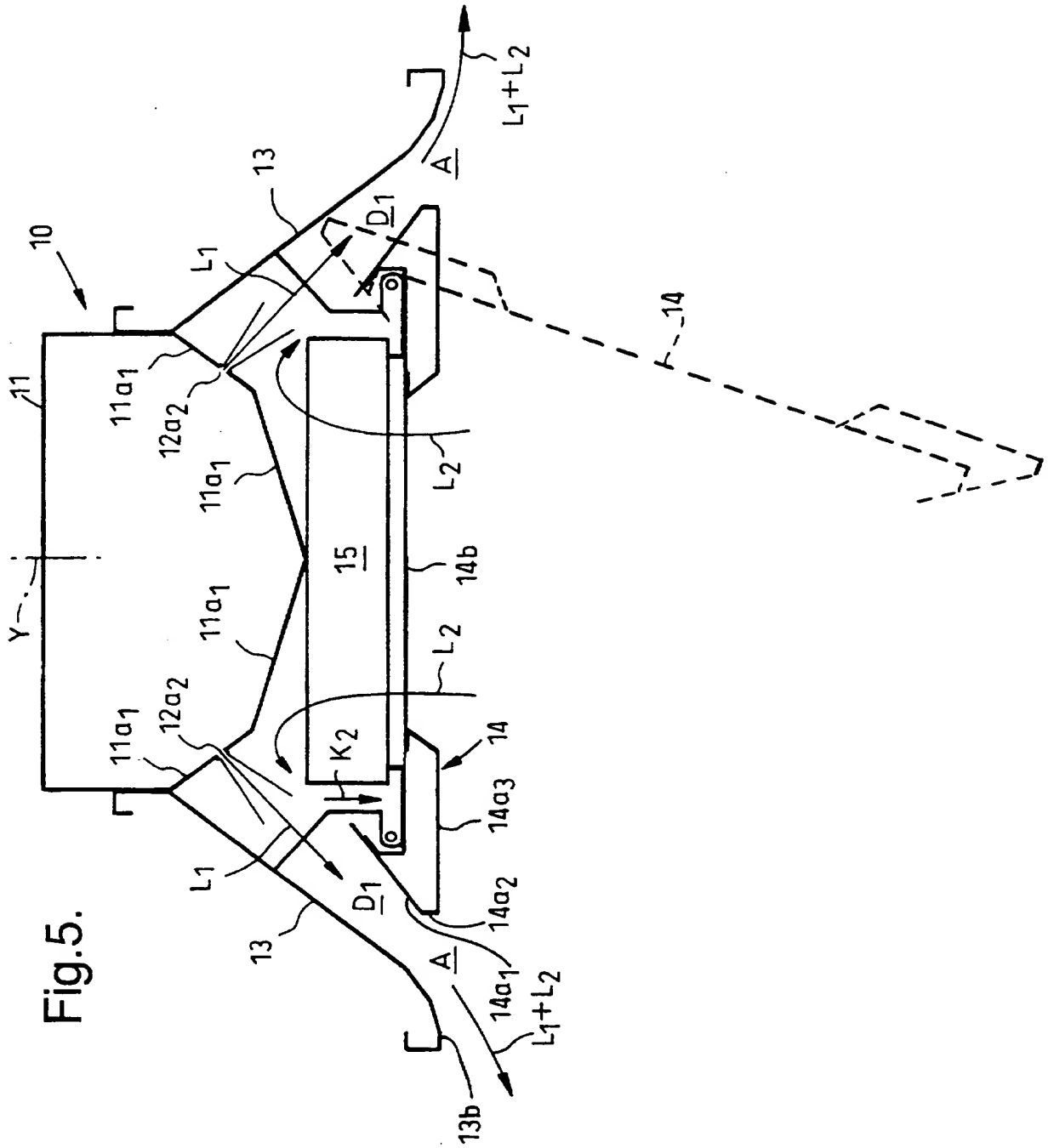

10
11
Y
11a1
12a2
L1
13
D1
A
L1+L2
14
L2
15
14b
K2
14a3
14a2
14a1
13b

Fig.5.

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AIR SUPPLY DEVICE

The present invention relates to an air supply device.

With regard to the prior art, reference is made to FI Pat. Appl. No. 970,919 filed by the applicant on an earlier date. From this publication is known as an air supply device comprising a heat exchanger structure and a distribution box through which the fresh supply air flow is passed into a side chamber and the combined flow of circulating air and fresh supply air is directed laterally out from the device structure. As the entire distribution box can be rotated out from the space between the side plates, the structure is easily cleanable.

Further background art can be found in patent publication DE 33 21 612A, which is related to a so-called closed distribution box structure.

The present application discloses a novel type of closed distribution box structure in which the air flow is circulated from the room space centrally through the air supply device and its heat exchanger under induction generated by guided discharge of fresh air from diffuser nozzles. The combined air flow $L_1 + L_2$ of the fresh air supply and the circulating air is passed out and laterally from the air supply device. The distribution box structure directs the flow of the fresh air supply first obliquely downwardly and the combined air flow is then directed laterally outwardly from the device along the underside surface of the suspended ceiling. According to the invention, the fresh air inlet channel is located uppermost and the nozzles attached thereto are disposed on both sides of the distribution box structure. Lateral air

flow guide plates are mounted to the sides of the distribution box that terminates the fresh air inlet channel. To the underside of the fresh air inlet channel, there is provided a heat exchanger through which the room air is circulated for heating or cooling. From the heat exchanger, the circulating air is passed to join the fresh air supply flow and the combined air flow $L_1 + L_2$ is directed laterally away from the supply air device under the control of the air flow guide elements. According to the invention, there is provided a separate, detachable air diffuser assembly that snap-locks in place and is also arranged to be hingedly releasable by the same snap-lock means to rotate away from its connection to the heat exchanger structure, thus permitting easy cleaning of the heat exchanger and the interior of the air supply device. The construction is longitudinally symmetrical with regard to its vertical center plane Y and, consequently, the air flow is encouraged to pass/circulate about both sides of the supply air device and further into the room space.

The air diffuser assembly, which according to the invention is hingedly rotatable and detachable, is comprised of air flow guide structures at its sides made from solid sheet metal by pressing and of a perforated plate at its center. A particular perforation pattern can be selected for a specific application from a group of preperforated metal plates. The underside of the laterally disposed air diffuser assembly forms the lower-most part of the device and is aligned flush with underside of the laterally horizontally bent portion of the side plates. In this manner, the entire structure can be mounted flush with the underside of a suspended ceiling, whereby the air flow guide elements of the diffuser assembly force the air to flow laterally outward from the structure so as to follow the underside surface of the suspended ceiling.

According to one aspect of the present invention, there is provided an air supply device comprising a distribution box for an inlet air duct (T), said distribution box having air discharge holes made thereto for discharge of fresh supply air, said air discharge inducing the flow of circulating room air (L_2) to pass via a heat exchanger located below said distribution box, whereby the air supply device induces the circulating air (L_2) entering from the room space in the direction of arrow (L_2) to pass centrally via said heat exchanger and further induces the circulating air leaving said heat exchanger to join the flow of fresh supply air (L_1) blown from air discharge holes, whereby the combined air flow ($L_1 + L_2$) is passed further into a channel (D_1) formed by a side plate connected to said distribution box (11) and a nozzle part of an air diffuser assembly and therefrom further under the guidance of said channel/guide elements laterally sideways from said air supply device, advantageously parallel to the underside surface of a suspended ceiling, **characterized** in that said air supply device includes a separate removable air diffuser assembly mounted below said heat exchanger, wherein said air diffuser assembly is adapted rotatable aside supported by locking/hinge means or entirely removable by releasing said locking/hinge means in order to provide access for cleaning the structure.

According to a further aspect of the present invention, there is provided an air distribution device comprising: (i) a distribution box having a plurality of discharge holes provided along a first and second side of said distribution box, wherein said first and second sides are opposite to each other; (ii) a first side plate connected to said first side of said distribution box and a second side plate connected to said second side of said distribution box, wherein each side plate extends at an

oblique angle with reference to said sides of the distribution box from a position above said discharge holes; (iii) a heat exchanger positioned below said distribution box; and (iv) an air diffuser assembly hingeably mounted below said heat exchanger so as to allow said air diffuser assembly to be swung away from said device, or to be detached completely from said device, and having a nozzle portion provided on each side of said air diffuser assembly which, together with the inner wall of each side plate, constitutes a channel, tapered in the direction of air flow discharged from said discharge holes; and wherein air supplied to said distribution box is discharged from said discharge holes and directed through said tapered channel into a room, thereby encouraging room air to pass through said heat exchanger into said tapered channel.

For a better understanding of the present invention, and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Fig. 1 illustrates schematically an air supply device according to the invention in axonometric partial view;

Fig. 2 illustrates in a detail view the separate air diffuser assembly featuring a hingedly mounted and removable structure;

Fig. 3A illustrates a side view of the distribution box structure of the air supply device;

Fig. 3B illustrates a sectional view of Fig. 3A taken along line I - I;

Fig. 3C illustrates an axonometric view of the distribution box;

Fig. 3D illustrates a bottom view of the distribution box of Fig. 3C with the air diffuser assembly 14 detached therefrom;

Fig. 3E illustrates the hinge/locking means in a separate top view of the air diffuser assembly as seen from the direction of arrow K_2 in Fig. 3;

Fig. 4A illustrates in a separate view the locking/hinge parts $16a_1$, $16a_2$ that are joined to the connecting part 70, said connecting part being further connectable to the structure of the air diffuser assembly 14;

Fig. 4B illustrates the structure of Fig. 4A from the direction of arrow K_3; and

Fig. 5 illustrates the air diffuser assembly 14 rotated into its cleaning position.

In Fig. 1 is shown an embodiment of the air supply device 10 according to the present invention. The air supply device 10 includes a fresh air inlet channel T as the uppermost part of the distribution box 11 in the air supply device structure. The structure is longitudinally symmetrical with regard to the vertical center plane Y of the device. The distribution box 11 includes nozzles $12a_1$, $12a_2$, $12a_3$…, through which the inlet flow of fresh air L_1 is directed into the narrowing channel D_1 formed between the side plate 13 and the nozzle part $14a_1$ of the air diffuser assembly 14. The planar surface of the nozzle part $14a_1$ is in the same manner as the side plate 13 inclined with respect to the vertical plane Y, whereby these parts cause a sideways deflected discharge of the

air flow. In this manner, the air exits from the air supply device laterally sideways along the underside surface of the suspended ceiling. The underside of the laterally disposed horizontal air flow guide plate 14b forms the lowermost plane of the device and this plane is flush with the underside of the laterally horizontally bent portion 13b of the side plate 13.

The device according to the invention accomplishes circulation of the room air L_2 via the heat exchanger 13 under the induction of the fresh air flow L_1, and the combined air flow $L_1 + L_2$ of the fresh air supply and the circulating air that is mixed in the channel section D_1 is directed sideways laterally away from the device along the underside surface of the room ceiling.

The center of the air diffuser assembly 14 is provided with a perforated plate 14b whose perforation pattern a_1, a_2... has been selected advantageously so that air is discharged at a desired flow rate at desired points along the longitudinal axis of the distribution box.

The pattern on the perforated plate 14b can be prefabricated to meet, e.g., any specific room interior decoration needs. Thence, the air diffuser assembly 14 is provided with a perforated plate 14b having a design tailored to the intended application.

In Fig. 2 shows the air diffuser assembly 14 in a separate axonometric view. The air diffuser assembly 14 provides at its center a perforated plate 14b. The perforation of the plate 14b is denoted by letter symbols a_1, a_2 ... The perforation pattern can be designed in a desired manner so that a specified flow rate is discharged at desired points via the heat exchanger 15 along the longitudinal axis of the distribution box. The perforated plate 14b has so-

called nozzle parts 14a formed on both sides of the plate. The nozzle part 14a comprises a first bent plate portion $14a_1$ and, adjoining therewith, a shorter plate portion $14a_2$ and a horizontal plate portion $14a_3$. The plate portion $14a_1$ functions as a wall delineating the channel D_1 and said plate portion $14a_1$ is bent so that, when the air diffuser assembly 14 is in its proper working position, said plate portion is situated inclined with respect to the vertical plane Y. The plate portion constitutes one side of the channel D_1, whose other wall is formed by the side plate 13, wherein the incline of said plate portion causes the channel D_1 to taper in the direction of the air flow. This arrangement accelerates the velocity of the combined flow $L_1 + L_2$.

In Fig. 3A is shown a side view of the air supply device 10 and its distribution box structure 11. The fresh air supply flow is passed via a separate inlet channel ductwork S into a connection box 20. The air flow can be directed into the connection box 20, either along the axis of the distribution box, from above or from either side. The bottom of the connection box is provided with a removable cleaning hatch cover 30 that facilitates the cleaning the interior of both the channel T of the distribution box 11 itself as well as the inlet channel ductwork S feeding the same. By first opening the cover 30, it is also possible to install a measurement device, valve or any other accessory to the interior of the connection box 20. As shown in the diagram, the heat exchanger 15, is disposed to the side of the distribution box 11 and the heating medium piping 40, which is connected to the heat exchanger 15 may be introduced via the end of the supply air device and then connected to the heat exchanger 15 in a conventional manner. With the help of the heat exchanger 15, the air passed via the heat exchanger can be either cooled or heated.

In Fig. 3B is shown a sectional view of Fig. 3A taken along line I - I. As is evident from Fig. 3B, the room air flow L_2 is passed centrally through the heat exchanger 15. While conventional finned heat exchangers are advantageously used herein, the heat exchanger construction may as well be of any other type. As shown in Fig. 3B, the air flow is passed via the heat exchanger 15 and this air flow L_2 is induced by the fresh air flow L_1 as it is discharged from the distribution box 11. As is further evident from Fig. 3B, the distribution box 11 has a polygonal cross section formed by the planar wall portions $11a_1$, $11a_2$ that are symmetrically disposed on both sides from the vertical center plane Y so as to delineate the space opening above the heat exchanger. The wall portion $11a_1$ is inclined to such an angle that the air discharge holes $12a_1$, $12a_2$... made thereto over the length of the distribution box 11 direct the air flow L_1 in a downward inclined manner towards a discharge opening A, wherefrom the combined air flow $L_1 + L_2$ is discharged in a laterally sideways deflected manner to meet the surface of the suspended ceiling and to follow the same due to the Coanda effect.

The distribution box 11 forming the channel T advantageously has a polygonal cross section, such as the heptagon shown in the diagram. Hence, the cross section of the illustrated embodiment has seven side walls of which wall portion $11a_1$ is so disposed that the air discharge holes made thereto will direct the air flow straight toward the discharge opening A.

Due to the symmetrical structure of the supply air device with respect to its vertical center plane Y as is evident from Fig. 3B, the air flow discharge to the other side of

the supply air device takes place in the same fashion as described above.

Fig. 3C shows the distribution box 11 axonometrically illustrated in the plane of the suspended ceiling M.

In Fig. 3D is shown the bottom view of the distribution box of Fig. 3C with the air diffuser assembly 14 removed. As is evident from the diagram, the air diffuser assembly 14 is mounted with the help of locking/hinge means $16a_1$, $16a_2$, $16a_3$, $16a_4$, the number of which is four, onto the end wall structures F_1 and 20 of the supply air device 10 so that the hinge pins $17a_1$, $17a_2$, $17a_3$ and $17a_4$ are inserted in respective hinge holes J_1, J_2, J_3 and J_4. The hinge holes J_1 and J_2 are located in the connection box 20 that also includes a cleaning hatch cover 30, which can be opened and closed by a screw. Hinge holes J_3, J_4 are respectively located on the end flange F_1.

In Fig. 3E is shown the air diffuser assembly of Fig. 3B as seen from above, that is, from the direction of arrow K_2. The air diffuser assembly 14 is provided with locking/hinge means $16a_1$, $16a_2$, $16a_3$ and $16a_4$ that are located in each of the four corners of the air diffuser assembly 14. Hinge pins $17a_1$, $17a_2$, $17a_3$, $17a_4$ of the locking/hinge means $16a_1$, $16a_2$, $16a_3$ and $16a_4$, respectively, are adapted to mate with the respective hinge holes J_1, J_2, J_3, J_3. Hinge pins $17a_1$, $17a_3$ on one side of the air supply device 10 can be moved simultaneously so as to allow the distribution box 14 to rotate, whereby the release of said hinge pins $17a_1$, $17a_3$ from their respective hinge holes J_1, J_3 permits the distribution box to hang supported by the other hinge pins $17a_2$ and $17a_4$. Correspondingly, it is possible to release the other hinge pins $17a_2$ and $17a_4$, whereby the distribution box rotates down supported by the hinge pins $17a_1$ and $17a_3$. Owing to the design of the

construction, it is also possible to release all the four hinge pins $17a_1$, $17a_2$, $17a_3$, $17a_4$ simultaneously from their hinge holes J_1, J_2, J_3, J_4, whereby the entire distribution box 14 can be removed. It must be noted, however, that in order to facilitate cleaning of the structure, the distribution box 14 is advantageously designed so as to allow the same to be rotated aside in order to provide access to the points of the internal structure of the air supply device, such as its heat exchanger 15, which require service and cleaning.

Fig. 4A illustrates the locking/hinge means $16a_1$ and $16a_2$ that are mounted onto a connecting body part 70. The connecting body part 70 can be attached to the distribution box 14 by means of screws, for instance. Herein, e.g., the hinge pin $17a_1$ is made movable against the spring force of a spring I. The spring I is adapted in the space between body part end plate 71 and a guide slot member 72 so that the spring I is inserted on the hinge pin $17a_1$. The hinge pin $71a_1$ is further guidedly passed through a hole made to the long section 73 of the connecting part 70.

In Fig. 4B are shown the details of the locking/hinge arrangement, now viewed from the direction of arrow K_3 in Fig. 4A. The guide slot member 72 is connected to the hinge pin $17a_1$, whose tip is passed through the hole made to the end plate 71. Being made from sheet metal, the guide slot member 72 is connected to both one end of the hinge pin $17a_1$ and to about the center of the hinge ping $17a_1$. The spring I is adapted in the space between the guide slot member 72 and the end plate 71 so precompressed as to drive the hinge pin $17a_1$ in the direction marked with arrow C_1 thus pushing the pin outward and into its respective hinge hole J_1. The other locking/hinge means $16a_2$, $16a_3$ and $16a_4$ function in the same manner. To open

the locking mechanism, the hinge pin $17a_1$ must be moved by the guide slot member 72 in the direction of arrow C_2.

In Fig. 5, the dashed-line part of the diagram shows the distribution box 14 rotated into its cleaning position supported by the hinge means $17a_2$, $17a_4$ of one side of the supply air device 14, whereby its interior spaces are readily accessible for cleaning. Thus, the interior structures such as the heat exchanger can be cleaned without effort.

CLAIMS:

1. Air supply device comprising a distribution box for an inlet air duct, said distribution box having air discharge holes made thereto for discharge of fresh supply air, said air discharge inducing the flow of circulating room air to pass via a heat exchanger located below said distribution box, whereby the air supply device induces the circulating air entering from the room space in the direction of arrow to pass centrally via said heat exchanger and further induces the circulating air leaving said heat exchanger to join the flow of fresh supply air blown from air discharge holes, whereby the combined air flow is passed further into a channel formed by a side plate connected to said distribution box and a nozzle part of of an air diffuser assembly, and therefrom further under the guidance of said channel/guide elements laterally sideways from said air supply device, advantageously parallel to the underside surface of a suspended ceiling, **characterized** in that said air supply device includes a separate removable air diffuser assembly mounted below said heat exchanger, wherein said air diffuser assembly is adapted rotatable aside supported by locking/hinge means or entirely removable by releasing said locking/hinge means in order to provide access for cleaning the structure.

2. An air distribution device comprising: (i) a distribution box having a plurality of discharge holes provided along a first and second side of said distribution box, wherein said first and second sides are opposite to each other; (ii) a first side plate connected to said first side of said distribution box and a second side plate connected to said second side of said distribution box, wherein each side plate extends at an oblique angle with

reference to said sides of the distribution box from a position above said discharge holes; (iii) a heat exchanger positioned below said distribution box; and (iv) an air diffuser assembly hingeably mounted below said heat exchanger so as to allow said air diffuser assembly to be swung away from said device, or to be detached completely from said device, and having a nozzle portion provided on each side of said air diffuser assembly which, together with the inner wall of each side plate, constitutes a channel, tapered in the direction of air flow discharged from said discharge holes; and wherein air supplied to said distribution box is discharged from said discharge holes and directed through said tapered channel into a room, thereby encouraging room air to pass through said heat exchanger into said tapered channel.

3. Air supply device according to claim 1 or 2, **characterized** in that said air discharge holes are located on a surface of said distribution box that is inclined at an angle with regard to the vertical center plane (Y) of the distribution box, whereby fresh supply air is blown from said air discharge holes directly into said channel and said discharge opening (A).

4. Air Supply device according to any of foregoing claims, **characterized** in that said device includes such locking/hinge means adapted between said distribution box and the other structures of said supply air device that permit the distribution box to be rotated in a desired manner supported on either said means located on side of the said device or, alternatively, on said means ($16a_2$, $16a_4$) located on the other sided of said device.

5. Air supply device according to any of foregoing claims, **characteriz d** in that said locking/hinge means is a hinge

pin, advantageously having a spring (I) adapted about said hinge pin, said spring (I) being adapted in the space between an end plate and a guide slot member connected to said hinge pin, whereby said hinge pin is releasable from its respective hinge hole by pushing said hinge pin by said guide slot member against the spring force exerted by said spring.

6. Air supply device according to any of foregoing claims, **characterized** in that said air supply device includes such a removable and/or rotatable distribution box that comprises a nozzle part disposed to both sides from the center plane of said air supply device, said nozzle part acting as one wall of a tapering channel and a said nozzle part having connected thereto a smaller, bent portion, to which is further connected a third planar portion, said latter portion being aligned horizontally so as form the lowermost surface of said air supply device, and that said planar portion further has connected thereto, either directly or with the help of an intermediate part, a centrally located perforated plate, said perforated plate acting as both a decoratively obscuring part and an air-flow guiding part, whereby modifications made to the perforation of said plate serve to control or direct in a desired manner the air flow entering said heat exchanger.

7. Air supply device according to any of foregoing claims, **characterized** in that said distribution box has a polygonal cross section of seven planar wall portions.

8. Air supply device according to any of foregoing claims, **characterized** in that, to the end of said distribution box acting as the termination of an air inlet channel, there is adapted a connection box having a cleaning hatch cover on its underside surface, whereby the removal of said

cleaning hatch cover facilitates the cleaning both the entire distribution box and the duct system connected thereto.

9. An air supply device substantially as hereinbefore described with reference to the accompanying diagram.

16.

Application No: GB 0003765.5 **Examiner:** Simon Berry
Claims searched: All **Date of search:** 30 August 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): F4V (VFYD, VFYM, VFYX)

Int Cl (Ed.7): F24F 1/01, 13/06, 13/24, 13/28, 13/30

Other: ONLINE DATABASES: EPODOC, WPI, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2322934 A	(HALTON OY) See especially Figure 1 and page 3, lines 9 to 32.	1 at least
Y	GB 2166863 A	(MITSUBISHI) See detachable air intake panel (36) in Figure 6.	1-3
Y	GB 1555563	(HOWORTH AIR ENGINEERING) See abstract and pivotal attachment of plate (13) in Figure 2.	1-4
Y	DE 3321612 A1	(WULF ET AL.) See WPI abstract and arrangement of ventilation unit in figure.	1-3
Y	FR 1347152	(ERCOLE MARELLI) See Figure 6. Note fresh air inlet nozzles 6 and airflow through heat exchangers 13.	1-4

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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